What is claimed is:

1. A Fourier domain optical coherence tomography (FDOCT) arrangement for measuring predetermined characteristics of an optically transparent object,

a broadband lightwave source for generating a broadband optical test signal;

an optical beam splitter including a pair of input arms and pair of output arms, a first input arm coupled to the output of the lightwave source for supporting the propagation of the broadband optical test signal through the optical beam splitter,

a lensing arrangement coupled to a first output arm of the optical beam splitter, the lensing arrangement for first collimating then focusing the broadband optical test signal; and

an optical spectrometer, coupled to the remaining input arm of the beam splitter, said optical spectrometer receptive to the plurality of interfering reflected signals from an optical transparent object disposed beyond the lensing arrangement, the optical spectrometer for providing a spectrogram signal of the interfering reflected signals and generating a fast Fourier transform of the spectrogram signal associated with the optical path length of the measured object, wherein signal peaks within the fast Fourier transform are related to transition interfaces between materials in the object and are associated with the predetermined characteristics of the optically transparent object.

2. The arrangement as defined in claim 1 wherein at least one predetermined characteristic of the optically transparent object is the thickness of a layer within the object, the thickness determined by filtering the peaks in the fast Fourier transform, performing an inverse fast Fourier transform on the filtered signal to retrieve a cosine waveform corresponding to the interference between two adjacent layers within the optically transparent object.

3. The arrangement as defined in claim 1 wherein the arrangement further comprises a polarizer element disposed within the lensing arrangement for separating the measured polarization signals into orthogonal modes.

4. The arrangement as defined in claim 1 wherein the arrangement further comprises a polarization beam splitter for capturing the plurality of interfering reflected signals and directing signals of a first polarization state toward said optical spectrometer and directing signals of a second, orthogonal polarization state toward a second optical

spectrometer so as to simultaneously capture information associated with both polarization states.

5. The arrangement as defined in claim 1 wherein the lensing arrangement comprises a first collimating lens and a second focusing lens.

6. The arrangement as defined in claim 1 wherein the lensing arrangement comprises an in-fiber beam expander coupled to the first output arm of the optical beam splitter.

7. The arrangement as defined in claim 1 wherein the lensing arrangement comprises a fiber tip collimator.

8. The arrangement as defined in claim 1 wherein the lensing arrangement comprises an in-fiber lensing element.

9. The arrangement as defined in claim 1 wherein the optical beam splitter is a 50:50 beam splitter.

10. The arrangement as defined in claim 8 wherein the broadband lightwave source comprises an erbium-doped fiber lightwave source.

11. The arrangement as defined in claim 1 wherein the broadband lightwave source comprises a continuum lightwave source.

12. The arrangement as defined in claim 1 wherein the arrangement further comprises an optical cavity disposed at the output of the arrangement beyond the lensing arrangement, with an optically transparent object to be measured to be disposed within the optical cavity.

13. The arrangement as defined in claim 1 wherein the arrangement is utilized with an optical fiber as the optically transparent object.

14. A method for determining characteristics of an optical fiber using a Fourier domain optical coherence tomography (FDOCT) technique, the method comprising the steps of:

illuminating the optical fiber, in a direction essentially perpendicular to the fiber axis, with a focused broadband light;

collecting reflected signals from each interface within the fiber structure at an optical spectrometer, the interfaces including the interfaces between air and the outer

fiber surface and interfaces between separate layers within the fiber structure, the reflected signals forming an interference pattern of a cosine signal form;

applying a fast Fourier transform to the interference pattern to generate a frequency domain representation associated with the optical path length of the optical fiber, where peaks in the fast Fourier transform are associated with interfaces between different layers within the fiber structure, allowing for the thickness of separate layers to be determined.

15. The method as defined in claim 14, wherein the method further comprises the steps of:

filtering the peaks within the generated fast Fourier transform;

applying an inverse fast Fourier transform to the filtered signal to retrieve a cosine waveform corresponding to the interference between any two adjacent interfaces; and

analyzing the cosine waveform to calculate the distance between any two interfaces within the optical fiber.

16. The method as defined in claim 14 wherein the method is used to measure the characteristic of eccentricity between the optical fiber and an outer coating layer, the method comprising the further steps of:

re-orienting the fiber with respect to the illuminating broadband light so as to illuminate the fiber surface at a location 90° from the initial set of measurements;

comparing the thickness results from the re-oriented set of measurements with the thickness results from the initial set of measurements, wherein a difference in thickness for the outer coating layer between the two set of measurements is indicative of the presence of eccentricity between the optical fiber and the outer coating layer.

17. The method as defined in claim 14 wherein the method is used to measure the characteristic of eccentricity between the optical fiber and an outer coating layer, the method comprising the further steps of:

applying the reflected signals as an input to a polarization beam splitter;

collecting reflected signals of a first polarization state at a first optical spectrometer;

collecting reflected signals of a second, orthogonal polarization state at a second optical spectrometer;

applying a fast Fourier transform to each of the interference patterns generated by the first and second optical spectrometers; and

comparing the thickness results associated with each fast Fourier transform, wherein a difference in thickness results for the outer coating layer between the orthogonal polarization states is indicative of the presence of eccentricity between the optical fiber and the outer coating layer.

18. The method as defined in claim 14 wherein the method is used to measure the characteristic of the presence of unwanted sub-surface features, the method comprising the further step of:

recognizing the presence of unwanted peaks in the FFT, unwanted peaks defined as any peaks not associated with known interfaces between different layers within the fiber structure.

19. The method as defined in claim 14 wherein the method is used to measure the characteristic of layer thickness for multiple coating layers, including a primary coating layer and at least one additional coating layer, wherein the method comprises the further step of comparing the peaks in the FFT and identifying the separate peaks associated with the interface between reflections from (i) the primary-coating/glass and secondary-coating/air interfaces, and (ii) secondary-coating/air and secondary-coating/primary-coating interfaces, the difference in these values associated with the thickness of the primary coating layer.

20. The method as defined in claim 14 wherein the method is utilized with a microstructured optical fiber comprising a plurality of regularly arranged air holes, the method measuring the fiber characteristics associated with the size and distribution of the air holes within the fiber.

21. The method as defined in claim 20 wherein the method comprises the further step of reviewing the FFT peaks, where the difference between successive peak locations is related to the separation between adjacent air holes.

22. The method as defined in claim 14 wherein the method is used to measure the characteristic of the effect of fiber tension during a draw process, the method comprising the further steps of:

determining the draw tension applied to the fiber, and for each weight:

controlling the polarization of the illuminating signal such that a first set of measurements is associated with the parallel polarization state of the illuminating signal, with respect to the fiber axis, and a second set of measurements is associated with the perpendicular polarization state of the illuminating signal, with respect to the fiber axis; generating a first spectrogram associated with the parallel polarization illumination and a second spectrogram associated with the perpendicular polarization illumination; and

comparing the difference in spectrograms for the parallel and perpendicular polarizations, the difference associated with the presence of birefringence in the fiber being drawn.

23. The method as defined in claim 14 wherein the method further comprises the step of placing the fiber in an optical cavity prior to illuminating the fiber so as to increase the number of reflective surfaces and provide additional information in the generated fast Fourier transform associated with the geometric thickness and optical thickness of the optical fiber.